PROGRESS REPORTS

FROM

EXPERIMENT STATIONS

SEASON 1961-62

TANGANYIKA LAKE REGION

PUBLISHED BY
THE EMPIRE COTTON GROWING CORPORATION
12 CHANTREY HOUSE, ECCLESTON STREET,
LONDON, S.W.1.
Editor: H. E. King, O.B.E.
1963

NSP
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COMMONWEALTH MYCOLOGICAL
16 AUG 1963

E.C.G.C. STAFF LIST

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TANGANYIKA LAKE REGION

PROGRESS REPORT FOR THE SEASON 1961-62

COTTON SEASON

Western Research Centre, Ukiriguru

Sowing: November and December
Picking: May to July
Rainfall: Ukiriguru, 1st October 1961 to 30th June 1962, 51·51 inches

INTRODUCTION

BY

G. M. WICKENS

Staff.—Dr G. M. Wickens returned from leave on 9th November 1961, having visited Wad Medani, Shambat and Namulonge *en route.* Mr W. Reed arrived on transfer from Northern Nigeria on 12th February 1962. Mr K. J. Brown and Mr J. E. Cross attended a Specialist Committee on Agricultural botany conference in Uganda in October 1961. All members of the staff visited Namulonge at least once. Dr Wickens visited the Nyanza Province of Kenya, at the request of the Kenya Department of Agriculture, to investigate and report on outbreaks of cotton wilt.

Seasonal conditions and crop production, Lake Region.—The season was abnormally wet. Rainfall at Ukiriguru from October 1961 to June 1962 inclusive was the second highest, and for the twelve months to the end of September 1962 the highest, recorded since records started in 1931. The monthly totals and averages for comparison are given in Table 1. In the areas of higher rainfall, rainfall this season was excessive. Copious early rains also led to much sowing of early maize, and this to an unusually heavy attack on cotton by American bollworm. These two factors caused cotton production from these areas to be lower than in previous years. On the other hand, the normally drier areas to the south benefited from the higher than average rainfall, and production was greatly increased. The net result was a record crop of about 195,000 bales.

Review of the work on cotton at Ukiriguru.—For the first time, the first multiplication of a new seed issue (UK61) has been made at Ukiriguru. One major advantage of this is that the chosen likely components are grown separately, to provide commercially processed bales of lint for quality judgment. About five tons of seed were produced from the six components finally chosen to compose the multiline.

TABLE 1

METEOROLOGICAL DATA, UKIRIGURU, OCTOBER 1961 TO SEPTEMBER 1962

Latitude 2° 42′ S, longitude 33° 1′ E, altitude 3,933 ft

Averages for comparison are given in parentheses

Month	*Rainfall*				*Vapour pressure*		*Relative humidity %*				*Air temperature °C screen*				*Sunshine hours per day Campbell Stokes*		*Evaporation inches computed**
	inches		*days 0·01 or more*		*0900 hrs*	*1500 hrs*	*0900 hrs*		*1500 hrs*		*mean maximum*		*mean minimum*				
		(a)		(a)				(b)		(b)		(b)		(b)		(c)	
Oct. 1961	6·13	(1·63)	19	(6·0)	0·536	0·499	65	(63)	47	(41)	28·5	(30·0)	18·2	(18·6)	7·7	(8·1)	7·33
November	10·27	(4·04)	20	(12·1)	0·575	0·575	83	(73)	69	(51)	25·3	(28·5)	17·7	(18·6)	4·4	(6 3)	5·00
December	9·09	(4·24)	19	(12·5)	0·616	0·575	85	(77)	73	(54)	25·3	(27·7)	17·5	(18·2)	4·8	(6·9)	4·28
Jan. 1962	6·86	(3·72)	15	(10·4)	0·616	0·555	88	(80)	64	(53)	26·1	(28·2)	17·5	(18·1)	5·3	(6·9)	5·28
February	4·06	(3·38)	10	(9·7)	0·732	0·499	72	(76)	45	(52)	29·2	(28·5)	17·8	(18·2)	9·0	(7·1)	6·98
March	4·56	(4·80)	10	(12·9)	0·595	0·555	81	(80)	58	(53)	27·8	(28·5)	17·5	(18·2)	7·6	(6·6)	6·53
April	3·43	(5·40)	10	(14·6)	0·595	0·575	83	(79)	62	(58)	27·3	(27·8)	17·6	(17·9)	7·0	(7·5)	5·96
May	6·86	(2·87)	11	(9·4)	0·575	0·555	80	(79)	57	(53)	26·8	(27·8)	16·6	(17·5)	7·7	(8·6)	5·77
June	0·25	(0·39)	3	(1·8)	0·482	0·465	67	(72)	44	(43)	28·3	(28·6)	15·8	(16·1)	8·5	(9·6)	5·75
July	0·39	(0·05)	2	(0·5)	0·402	0·347	64	(67)	32	(39)	28·6	(28·7)	14·4	(15·3)	10·0	(9·8)	6·45
August	0·76	(0·44)	4	(2·0)	0·417	0·373	59	(66)	38	(39)	28·7	(29·1)	15·9	(16·6)	8·3	(8·8)	6·75
September	0·91	(0·88)	3	(3·3)	0·432	0·402	55	(62)	35	(40)	30·4	(30·0)	17·6	(17·9)	7·7	(7·3)	7·59
Totals	53·57	(31·84)	126	(95·2)													73·67
Means					0·548	0·498	74	(73)	52	(48)	27·7	(28·6)	17·0	(17·6)	7·3	(7·8)	6·14

*From Penman equation, using values of radiation from Gunn-Bellani integrator

(*a*) average for years 1931 to 1962 (*b*) average for years 1946 to 1962 (*c*) average for years 1960 to 1962

Strain trials confirmed the potentiality of these components for higher yield than the present commercially-grown UK55 and UK58, through their resistance to bacterial blight. The performance of other progenies in this family promises the formulation of a still superior UK63.

For the southern areas, usually harder climatically and producing a somewhat shorter and coarser lint, emphasis is on high yield and high ginning percentage. These are found in the UKA 67 (most strongly) and UKA 121 families of Albar hybrids. In strain trials at Ukiriguru and four other sites in the southern areas, progenies of these families averaged up to 40 per cent increase of lint yield over UK55, and ginning percentages were up to 37·9 compared with 33·9. A number of these progenies, mainly in UKA 67, have been selected on yield performance and lint quality for multiplication on Ukiriguru as probable components of UK62. It is confidently anticipated that this seed issue will lead to markedly increased production in the southern areas of the order of 20 to 25 per cent.

Work has been started on crosses between and within families of Albar hybrids, on the performance of mechanical mixtures of progenies in varying proportions, and on the extent of natural outcrossing in the field, primarily to provide a wider basis of knowledge through which the full potentialities of multiline seed issues could be exploited.

Notable developments in the bacterial blight resistance work have been: (1) development of a glasshouse inoculation method whereby equal concentrations of the pathogen from different sources can be inoculated into a range of host differentials, without the bacteria being at any time multiplied in artificial culture, and (2) by means of this method, demonstration that populations of the bacteria in lesions on an Albar hybrid progeny differed from populations in the moderately resistant UK55, in that they were much more virulent to a number of progenies carrying Albar resistance, although not more virulent to a number of other genotypes. Thus it seems evident that, in the field, an Albar hybrid has caused selective multiplication of a race or races of the bacterium that can, when artificially inoculated to plants in the glasshouse, break down the resistance of Albar hybrids that has been manifested against the normal pathogen population. It remains to determine whether this breakdown of resistance can occur in the field. If it can, then further selection, and perhaps breeding, for high resistance to the more virulent population will be necessary.

As an aid to the evaluation of new selections for their suitability to areas of different rainfall distributions, rate of growth and fruiting studies have been made on the three Albar hybrid families, in comparison with the already established commercial seed issues. Large variations have been found. Present evidence suggests that, in the

long-season areas of more reliable rainfall, a strongly indeterminate and leisurely growth habit is the more suitable. This characteristic is also beneficial in years of relatively heavy bollworm attack, which may well increase in frequency. In areas of more restricted rainfall and shorter effective season where, in general, bollworm attack is unimportant, but stainer attack can be damaging, it is the more rapidly growing and fruiting types of more determinate habit that have given conspicuously high yields.

In the past, material loss of crop through American and spiny bollworm attack, has been only occasional and sporadic. The changing conditions of local peasant agriculture, particularly the increasing culture of early-sown maize and the beginnings of better farming practices leading, it is hoped, to much higher yields per acre generally, have pointed the need for much more knowledge of the biology of these pests and possibilities of economic insecticidal control. Population studies of these pests on their various host plants throughout the year, and studies of their life histories in the laboratory and in the field, have now begun. These, together with observations on loss of crop, will provide the knowledge on which control of these pests, if found to be necessary or economic, will be based.

Predation and parasitism have been found to be more intense than formerly realised. DDT severely reduced this natural control; applications early in the season resulted in later large increases in populations of *Heliothis armigera* and *Earias* spp.

In field tests of insecticides, DDT at 1 lb a.i. per acre gave adequate control, whereas Sevin at 1·5 lb a.i. per acre and toxaphene at 3 lb a.i. per acre did not.

Work on water utilization by the cotton crop, and on soil fertility and fertilizers, has continued. The ratio of potential evapotranspiration to open water surface evaporation has not exceeded 1·0 even under a crop yielding more than 2,000 lb seed cotton per acre. At the time of rapid vegetative growth the ratio was 0·9 to 1·0, agreeing well with theoretical calculations. Further evidence on the nutritional importance of calcium on the hillsands has been obtained.

Fusarium wilt has continued to spread, and new, widely-scattered foci of infection have been found in the East Lake areas. Circumstantial evidence suggested that superfluous seed husk left after decortication at oil-extraction mills might have been the origin of these new foci. The possibility has been confirmed by detection of the pathogen in the seed coats of seeds taken from infected plants.

Local top soils have been found commonly to show strong microbiological fungistasis against the pathogen, but exceptions, possibly of practical significance in successful establishment of new foci of infection, have been noted. The effect has been found

strongest where superphosphate and dung have been applied, sulphate of ammonia appears to have weakened it. Effects of soil factors on survival are also being studied.

A technique has been developed whereby large numbers of seedlings can be uniformly inoculated with the *Fusarium* in a single glasshouse experiment. By this means, a high degree of heritability of resistance in the UKA G2.1 family has been demonstrated. It is still necessary to check that this resistance is effective under field conditions, in the presence of root-knot eelworm.

Cotton Breeding

BY

K. J. BROWN AND J. E. CROSS

This season, UK58 covered the Northern zone of the Lake Region, being grown in the areas of Mugango, Ushashi and Kibara ginneries. It is now generally accepted that under commercial conditions the ginning percentage has been raised by this seed issue, and percentages approaching 34·0 have been mentioned. The seed cotton yields also were higher than those obtained with the previous seed issue, UK51, and all sections of the cotton industry will undoubtedly benefit from the use of this variety.

Part of the southern zone covered by Mhunze and Usagore ginneries grew UK55. This variety is similar to UK58 in most of its agronomic and lint characteristics and has performed extremely well in this area, the main advantages being a high yield of seed cotton, high ginning percentage and adequate jassid resistance. In this area, the extra rainfall this season was advantageous as it allowed earlier sowing than is usual, and the checks to growth, due to dry mid-season conditions, were less severe. As a consequence of the satisfactory conditions, the total crop of this area was a record, but some credit for this exceptionally large crop can fairly be claimed for the UK55 variety used. In the coming season there should be sufficient seed of this variety to supply all areas apart from the UK58 area. See sketch map (Fig. 1).

On Ukiriguru, eight possible components of UK61 were chosen for multiplication. The best of these were destined to form the first multiline seed issue composed of Albar hybrid selections in the UKA G2.1 family. Approximately 45 acres were sown, and after harvest and ginning, the lint was baled and submitted for inspection by the officers of the Lint and Seed Marketing Board in Mwanza and Dar-es-Salaam. Satisfaction was expressed with the lint, and six of

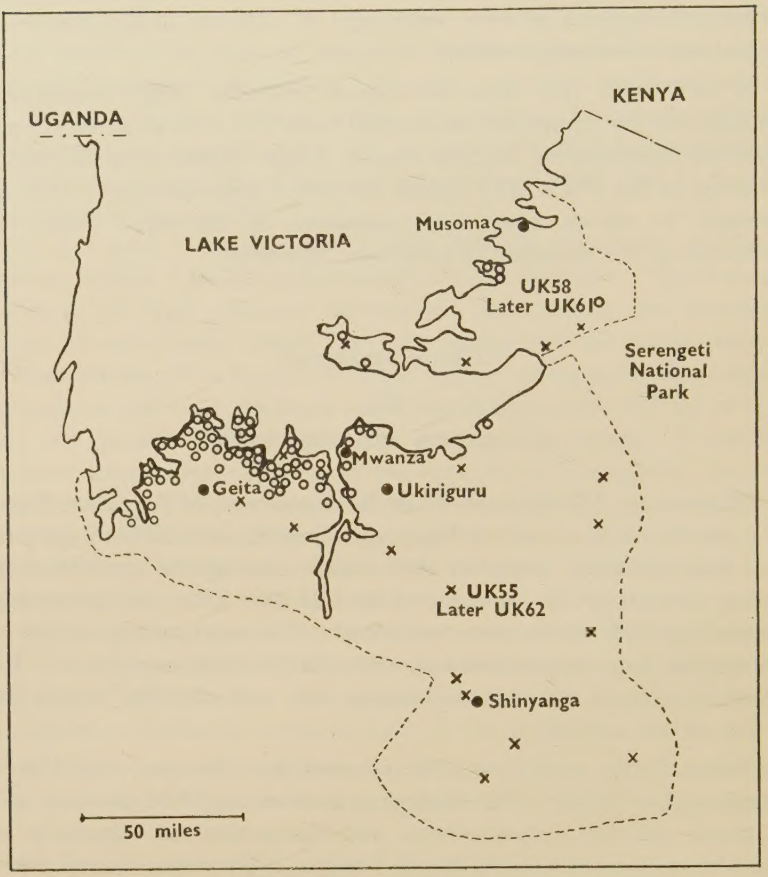

FIGURE 1

SKETCH MAP OF LAKE REGION COTTON GROWING AREA

O Distribution of Fusarium wilt

X Variety trial sites

the selections have since been mixed to form the first nucleus stock of seed for issue to the Extension Division of the Ministry of Agriculture. This seed is, at the time of writing, being sown for multiplication in a part of Kibara ginnery area in the Northern zone. Approximately 600 acres are expected to be grown.

Strain trials at Ukiriguru this season have shown that under some conditions the components of UK61 may be higher yielding than UK58. Yields are given in Table 2.

TABLE 2

VARIETY TESTS FOR NORTHERN ZONE SEED ISSUE

Yields of UK61 components in comparison with UK58

Strain	*Ukiriguru V.T. lint lb per acre*	*Ukiriguru and District V.T.s lint yield as % UK58*	*Ginning percentage*
UKA G2.1/I7/904	276	96	35·2
UKA 59/206	242	92	34·6
UKA 59/209	272	96	36·5
UKA G2.1/I7/185	248	104	35·4
UKA 59/494	226	101	34·9
UKA 59/515	257	113	36·9
UK58	212	100	34·4

Earlier work has shown that selections in the UKA G2.1 family of Albar hybrids are at least equal in yielding capacity to the UK varieties in the absence of bacterial blight, and surpass them when conditions are favourable to the disease. Bacterial blight was prevalent at Ukiriguru this season, and this is undoubtedly the reason for the relatively good performance of the components of UK61 on Ukiriguru. The chief advantages of UK61 will be its disease resistance, improved lint quality and improved ginning percentage.

Apart from the Northern zone (at present growing UK58) which will receive UK61, the rest of Lake Region is destined to receive a multiline seed issue designated UK62 in replacement of UK55. A number of selections were tested this season as possible components of UK62. It can be seen from Table 3 that these selections constitute a major advance in yield and that the ginning percentages are very high. Strain UKA 67/I7/86 was considered by the lint classifiers to have particularly good lint and this, together with twelve other selections, is being multiplied in the coming season on Ukiriguru. The final decision on the components for UK62 will be made after the 1963

TABLE 3

VARIETY TESTS FOR SOUTHERN ZONE SEED ISSUE

Yields of some possible components of UK62 in comparison with UK55 in Ukiriguru and district V.T.s

Strain	*Lint lb per acre*	*Lint yield as % UK55*	*Ginning percentage*
UKA 67/I7/86	281	138	37·7
UKA 59/376	230	113	37·9
UKA 59/242	287	141	37·7
UKA 59/245	275	135	37·9
UKA 59/247	270	133	37·8
UKA 59/387	251	124	37·7
UKA 59/264	233	115	37·5
UK55	203	100	33·9

harvest, but this seed issue could show as much as a 20 to 25 per cent yield increase over current varieties.

Single plant selections have been tested in replicated progeny row trials for a number of years, but the lengthy calculations necessary have usually made the computation of a selection index impracticable. However, we were fortunate in having Mr G. de Bruyn, a student of Wageningen, to analyse the three trials covering the main families of hybrid material which were sown this season. In most cases the heritabilities of the various traits used to construct the selection index were high. This contrasts with the low heritabilities reported in the 1960-61 Progress Report and suggests that in fact there is still much genetic variation left in the Albar hybrid material which is exploitable. The actual heritabilities are given in Table 4.

TABLE 4

HERITABILITIES OF TRAITS USED TO COMPUTE THE 1962 SELECTION INDEX

Albar hybrid family	*Lint per stand*	*Seeds per boll*	*Lint per seed*
UKA G2.1	0·617	0·837	0·857
UKA 121	zero	0·283	0·500
UKA 67	0·853	0·578	0·137

Crosses between and within families have been made, and will be studied during the coming season for evidence of heterotic effects. It is conceivable that selections from the inter-family crosses will combine high yield with superior lint quality

Work on mixtures and proportions in a multiline variety has started. It is hoped to arrive at some formula for constituting new multilines. Three distinct types have been mixed in varying proportions, and the mixtures are being evaluated.

The male sterile character is being introduced into a range of Albar hybrids. Male sterile testers will be produced which may be used to measure combining ability between possible multiline components.

Over 200 samples were sent for fibre testing at Namulonge, and 71 lint samples were sent to the Shirley Institute.

AGRONOMY AND CROP PHYSIOLOGY

BY

K. J. BROWN

Agronomy

There were three factors this season which, acting independently or in combination, tended to reduce cotton yields. Firstly there was the loss caused by American bollworm in many areas; details of this

attack are given in the report of the Entomologist. Secondly, the high rainfall reduced yields in many areas although, for reasons mentioned in the breeding section, Shinyanga in the south has benefited. In a recent paper (Brown, 1963) it was shown that at Ukiriguru the optimum rainfall from December to March, for cotton production, is about 18 inches. Rainfall during this period this season was 25 inches. Excessive leaching of the soil nitrates may have occurred, and also many reports of rotting of seed and young plants have been received from the district. Thirdly, bacterial blight caused loss on relatively susceptible varieties of local origin.

As in previous reports, the yields from the "High Field" and "Exhaustion" plots are given in Table 5. In addition, the yield of the "B" plot is given. This plot has received a dressing of farmyard manure rotationally on a quarter of the area each year, at the rate of 5 tons per acre—an application that could easily be made by local farmers using ox carts.

The exhaustion plot has now been continuously cultivated for twenty-three years without the addition of nutrients in any form. The yield this season was exceptionally low and the nutrient deficiency on this plot has been further accentuated by the excessive leaching caused by heavy rain.

The high field plot is now in its sixth year of cultivation. The yearly addition of 5 tons of farmyard manure plus the standard recommended application of artificial fertilizers has evidently maintained high yields over a wide range of rainfall. It can be seen in Table 5 that although there was apparently a depression in yield on the high field plot, this was mostly caused by the reduction in yield of the variety UK58, which is relatively susceptible to bacterial blight.

TABLE 5

VARIATION IN YIELD FROM DIFFERENT LEVELS OF COTTON NUTRITION

Yields of seed cotton in lb per acre

Year	*Exhaustion plot "A" no manure for 23 years*	*"High Field" farmyard manure and fertilizers every year*	*"B" plot farmyard manure applied in rotation yearly to ¼ of the plot*
1957	413	2,050	1,259
1958	508	2,300	1,175
1959	546	1,083	—
1960	375	1,828	996
1961	382	1,974	964
1962	195	1,680	712
Mean	403	1,819	1,021
1962			
UK58	199	1,490	—
UKA 121/I7/174	190	1,870	—

The "B" plot gave a low yield compared with the mean for ten years. The yields for this period show a downward trend and it now becomes apparent that application of 5 tons per acre farmyard manure every four years in insufficient to maintain a high level of fertility. Extra nutrients will obviously be required in the form of more frequent applications of manure or additional artificial fertilizers.

On all these plots, no control of insects was practised as the level of attack was too low to justify such action economically. If insect control had been used it would probably have added a small additional increment by controlling spiny bollworm attack which was frequently present late in the season.

In a comparison of different types of fertilizer, containing nitrogen and phosphate, with the recommended standard dressing of 100 lb double superphosphate and 100 lb sulphate of ammonia per acre, it appeared that diammonium phosphate gave similar results to the standard dressing when applied at only 100 lb per acre. The use of monammonium phosphate resulted in approximately half the normal response when applied at the same rate of 100 lb per acre. This suggests that the nitrogen in this fertilizer (11%) was insufficient, although phosphate was adequate.

In conjunction with the Chemist, the effect of several nitrogen fertilizers on yield and soil pH is being investigated. The yield responses to all three nitrogen fertilizers (sulphate of ammonia, calcium ammonium nitrate and urea) were similar when used as top dressings. As an alternative to sulphate of ammonia, urea is better than the calcium ammonium nitrate because the latter is liable to become deliquescent if stored for even moderate periods of time. The results are given in Table 6.

TABLE 6

RESPONSE TO DIFFERENT TYPES OF NITROGEN FERTILIZER USED AS A TOP DRESSING

Weight of dressing per acre and type of nitrogen fertilizer	*Mean yield seed cotton lb per acre*	
Control (no nitrogen)	259	
66 lb sulphate of ammonia	380	+121
132 lb sulphate of ammonia	505	+246
100 lb calcium ammonium nitrate	494	+235
45 lb urea	560	+301
S.E.		± 23·3

In the ridging trial there was, this season, no interaction between variety and ridge spacing such as was reported in 1961. Table 7 gives the full results. There was a suggestion that a better yield was obtained on 3 ft ridges than on 5 ft ridges, but in the light of the evidence from previous experiments, it can only be concluded that considered on yield alone there is little to choose between the two ridge-spacings.

TABLE 7

VARIETY AND SIZE OF RIDGE EXPERIMENT

Yield seed cotton lb per acre

Variety	*3 ft ridge*	*5 ft ridge*	*Mean*
UK55	1,395	1,062	1,228
UKA 67/I7/86	1,482	1,375	1,428
UKA 121/I7/174	1,540	1,420	1,480
UKA G2.1/I7/904	1,238	1,182	1,210
			± 65·7
Mean	1,414	1,260	
	± 46·4		

Physiology

For two seasons, measurements have been made at Ukiriguru of the water requirements of the cotton crop. The ratio of potential evapotranspiration to the evaporation from an open water surface, calculated by the method of Penman, was determined whenever a drying cycle was indicated in the soil by the nylon resistance units.

Plaster jacketed nylon resistance units were supplied by the crop physiology section at Namulonge and placed at 1, 2, 3 and 4 ft depths under the ridge in both 3 ft and 5 ft ridges. Additional units were placed in the furrow, but the results of these have not been used in the calculations as it was obvious that the amount of soil moisture extracted was much greater under the ridge than the furrow. For this reason the values of Et are higher than they would have been if a mean for both the furrow and the ridge was calculated. The ratio Et/Eo in Table 8 is correspondingly high. The open water surface evaporation was calculated by the Penman method using figures for total radiation derived from a Gunn-Bellani radiation integrator.

The highest values of Et/Eo were obtained during the period from mid February to mid March (Table 8). The values obtained in late March and April were considerably lower. These lower values were associated with the reduction in the rate of vegetative growth by

TABLE 8

WATER UTILIZATION BY COTTON AT UKIRIGURU

Et/Eo *ratio for cotton during periods when drying cycles were indicated by resistance units*

Et = potential evapotranspiration

Eo = open water surface evaporation computed by the Penman method

Treatment		*1961*		*1962*		
		Feb. 15 to Mar. 16	*Apr. 12 to May 4*	*Mar. 6 to Mar. 20*	*Mar. 27 to Apr. 6*	*Apr. 18 to May 2*
55	3 ft ridge	0·90	0·66	0·95	0·69	0·60
55	5 ft ridge	0·89	0·72	0·96	0·59	0·60
A 67/I7/86	3 ft ridge	0·98	0·73	0·99	0·72	0·67
A 67/I7/86	5 ft ridge	0·95	0·68	1·08	0·74	0·77
ean		0 93	0·70	0·99	0·68	0·66

The mean yield of seed cotton per acre was 2,144 lb in 1961 and 1,337 lb in 1962

the plant after mid March. Up to this time, the leaf area was expanding at an exponential rate, but this rate decreased when the first fruiting bodies began to expand.

The values obtained are not greatly at variance with the values predicted by Penman. In both years, yields of seed cotton were high, and leaf area indices of between 1·5 and 2·0 were attained. Leaf areas greater than this are unlikely to occur in local raingrown cotton, and consequently the Et/Eo ratios given in Table 8 are unlikely to be exceeded.

It was reported in 1961 that partial defloration of well grown cotton of the selection UKA121/I7/174 could produce yield increases. A full-scale experiment was grown this season at Ukiriguru and also at Lubaga, a sub-station in Shinyanga District. At Ukiriguru there was a late attack by spiny bollworm which was partially controlled by spraying. No such facilities were available at Lubaga where the cotton suffered a fairly heavy pest attack.

The results are shown graphically in Fig. 2. At both sites, two varieties gave increased yield when all flowers appearing during the first ten days from start of flowering were removed, but longer deflowering either produced no such increase or led to substantial decrease. It is noteworthy that the selection UKA 67/I7/86 did not give this increase at either site. This may be a consequence of its quicker growth and earlier maturing habit and is of interest as this strain will be the main component of UK62 now being multiplied on Ukiriguru, for issue to the southern areas of Lake Region.

Although this treatment is artificial, it is helpful in understanding the reason why compensation for bollworm damage occurs in some seasons and not in others. The timing of the peak attack could be critical.

Field observations of the main Ukiriguru families of Albar hybrid material indicated that some were more vigorous than others. An experiment was grown including selections from all the main Albar hybrid families to measure various growth functions and determine what differences there were in rates of growth. Samples from four replications were taken at 10-day intervals, and the dry weights of leaves and structural parts determined. Table 9 shows the mean net assimilation rates of the selected representatives of the three main families. It can be seen that UKA 67/I7/86, the consistently highest yielding strain, had a higher rate for part of the vegetative period. This was reflected in a more rapid accumulation of dry matter. It may be possible to transfer this character of vigorous growth to other families of UKA material which have different lint quality.

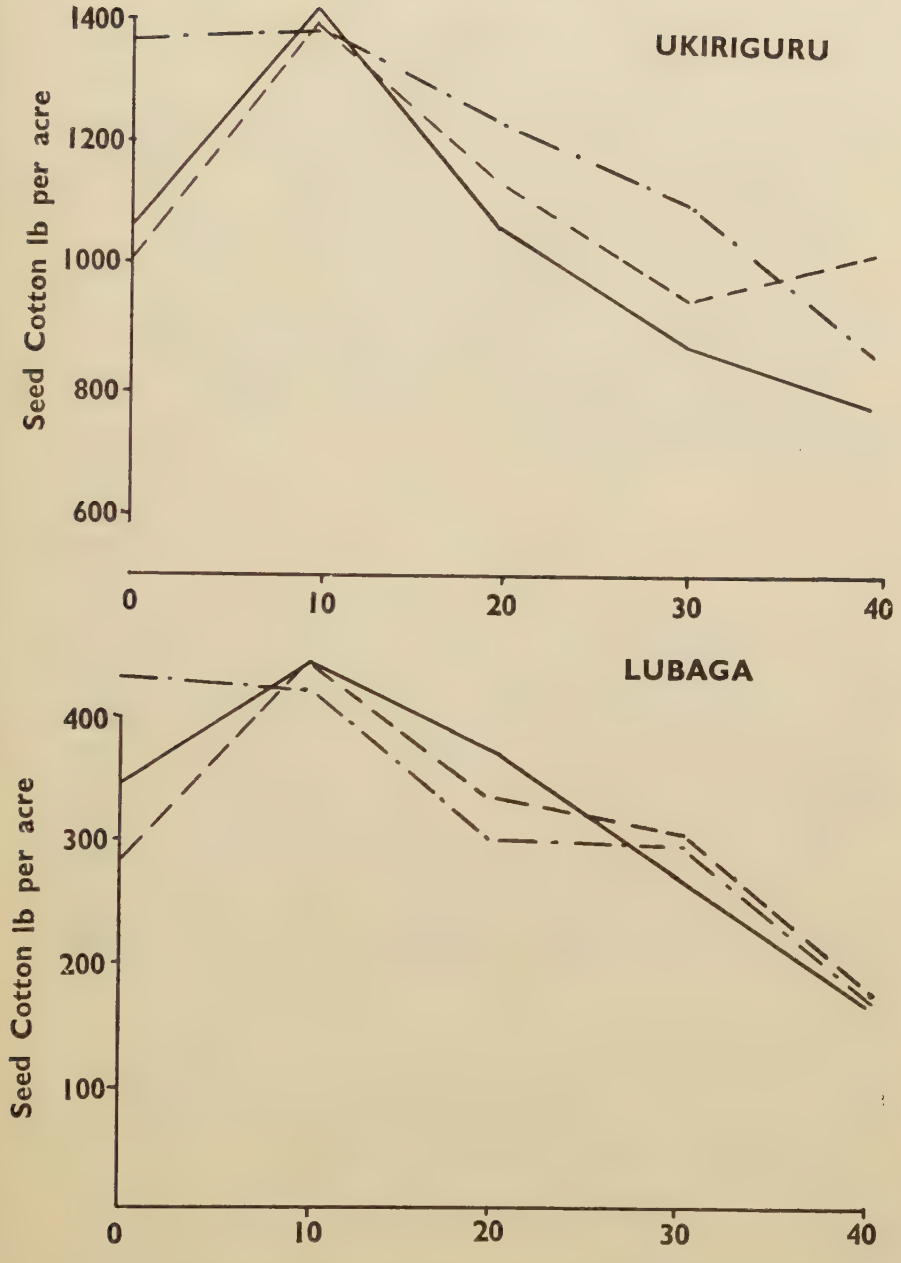

FIGURE 2

EFFECT OF FLOWER REMOVAL AT UKIRIGURU AND LUBAGA, 1962

———— Variety UK55
— — — Strain UKA 121/17/174
— . — . Strain UKA 67/17/86

TABLE 9

MEAN NET ASSIMILATION RATES OF COTTON

(gm per gm per week)

Family	*Days from sowing*			
	30 to 40	*40 to 50*	*50 to 60*	*60 to 70*
UKA 67/I7/86	1·891	1·483	1·381	0·942
UKA 121/I7/174	1·827	1·227	1·078	0·897
UKA G2.1/I7/904	1·766	1·156	1·097	0·826

The leaf dry weights of all varieties were similar, but measurements of leaf thickness later in the experiment showed that the leaves of UKA G2. 1/17/904 were appreciably thicker than those of other families. This group of selections is usually the lowest yielding of the three groups, and efficiency of assimilation may be associated with leaf thickness.

SOIL SCIENCE

BY

A. M. KABAARA

Observations in the 1960-61 season which indicated the possible importance of calcium in cotton nutrition on the hillsands were followed this season by three experiments in a glasshouse using soils from trial 26 (see later for details). Four kilograms of soil were used in pots made of polyethylene film. Fourfold replication of treatments was used in all experiments. Cotton was grown and yields of plant dry matter were recorded.

In two experiments the "minus-one" technique of applying nutrients was used. In experiment A the soil was from a plot which had received 6 tons of compost per acre in 1952, 1955 and 1959, whilst in experiment B soil from a nil plot was used. The growth periods were 13 weeks for experiment A and 16 weeks for B. The dry matter yields are given in Table 10.

TABLE 10

YIELDS OF DRY MATTER IN EXPERIMENTS A AND B (G PER POT)

	Expt. A—Soil from Compost plot	*Expt. B—Soil from Nil plot*
Complete (1)	11·4	21·8
Minus N	2·0	10·0
Minus P	4·9	9·4
Minus K	n.d.*	20·0
Minus Mg	n.d.	21·6
Minus Ca	7·4	16·1
Minus B	n.d.	21·6
Plus Fe(2)	n.d.	21·4
Plus micro-nutrients (3)	n.d.	21·2
Water only	1·9	1·7

*n.d.=not determined.

(1) Watering solution containing N, P, K, Mg, Ca, B
(2) Watering solution as in (1) plus Fe
(3) Watering solution as in (2) plus Mn, Zn, Cn, Mo.

The third experiment, C, was a 2^4 factorial design without confounding. The soil was from the compost plots of trial 26. The treatments were nitrogen, calcium and phosphorus applied in the watering solution, and compost (D) at 200 g per pot. The growth period was 14 weeks. Results from this experiment are in Table 11.

TABLE 11

YIELDS OF DRY MATTER IN EXPERIMENT C (G PER POT)

	(1)	Ca	D	CaD
(1)	2·8	3·1	2·9	3·4
N	5·9	4·5	11·9	21·1
P	2·5	2·5	2·9	4·3
NP	3·5	11·4	4·3	23·9
S.E.		±0·82		

In experiments A and B yields were very poor if all nutrients were withheld. Exclusion of nitrogen and phosphorus caused large yield depressions and lack of calcium also reduced yield. Exclusion of potassium, magnesium or boron had no effect, nor did the addition of micro-nutrients.

In experiment C yields were consistently low without nitrogen. In the presence of nitrogen the highest yields were given when calcium and compost were given together. There was no overall response to phosphorus but calcium plus phosphorus, and compost alone, gave modest yields. Compost appears to have supplied adequate phosphorus but inadequate nitrogen and calcium.

Considered together the three experiments indicate that for cotton plants grown in a small amount of soil in pots the addition of nitrogen, calcium and phosphorus was necessary.

Soil analysis was continued on samples taken from Trial 26, and Tables 12 and 13 show some of the figures and seed cotton yields in the 1961-62 season. The full details of the layout and manurial treatments for this trial are as follows.

Four replications of 2 × 2 factorial, with main plots split into four nitrogen treatments of 1/70 acre each.

p_0, p_1 0, 150 lb double superphosphate per acre applied in 1952, 1955, 1959, 1961.

d_0, d_1 0, 6 tons compost per acre applied in 1952, 1955, 1959, 1961.

n_0, n_1 0, 100 lb sulphate of ammonia per acre applied before sowing every year since 1959. In previous years n_1 was 50 lb applied at flowering.

n_2, n_3 100, 200 lb sulphate of ammonia per acre applied at flowering every year.

The yields during this season were greatly reduced, being approximately one-third of those for the 1959-60 season. The main reason was an attack of American bollworm as discussed elsewhere in this report.

Comparison of Table 12 with Table 13 shows that the yields are closely associated with the soil analytical data. The high yields of the

pd plots in Table 13, for example, may be compared with the figures for the same plots in Table 12. The low yield of the n_3 treatment is associated with a progressive acidification of the soil by sulphate of ammonia as mentioned in last year's report.

TABLE 12

SOME CHEMICAL ANALYTICAL DATA FROM DNP MANURIAL TRIAL 26
Sampled April 1961

	Depth sampled inches	*pH Paste*	*Exch. Ca m.e. per 100g*	*Total N %*	*Truog P mg per 100g*	*Exch. K m.e. per 100g*
Control	0- 6	5·94	1·48	0·013	0·25	0·41
	6-12	5·68	1·40	0·015	0·15	0·41
n	0- 6	5·70	1·49	0·022	0·25	0·33
	6-12	5·36	1·51	0·025	0·16	0·31
p	0- 6	5·76	1·46	0·018	0·55	0·31
	6-12	5·57	1·43	0·019	0·15	0·32
np	0- 6	4·63	1·50	0·027	0·29	0·20
	6-12	5·10	2·05	0·022	0·30	0·24
d	0- 6	6·13	1·94	0·028	0·30	0·56
	6-12	6·09	2·30	0·032	0·42	0·53
nd	0- 6	4·70	1·90	0·028	0·20	0·33
	6-12	5·00	1·97	0·027	0·17	0·33
pd	0- 6	6·27	2·63	0·030	1·30	0·52
	6-12	5·94	2·79	0·025	0·42	0·31
npd	0- 6	4·84	2·11	0·031	0·55	0·44
	6-12	5·08	2·13	0·029	n.d.	0·36

TABLE 13

SEED COTTON YIELDS IN DNP MANURIAL TRIAL 26, 1961-62
lb per acre

	(1)	*d*	*p*	*pd*
n_0	43	243	90	308
n_1	111	379	201	408
n_2	104	370	181	432
n_3	68	403	203	494

The analytical figures show that where compost and phosphate have been applied, calcium and phosphate and to a smaller extent nitrogen have been increased. Analysis of compost samples this season shows that a dressing of 6 tons per acre compost containing about 25% moisture may return up to 125 lb calcium per acre to the soil.

The figures for exchangeable potassium shown in the last column of Table 12 are of interest in view of the fact that no responses have been obtained on Ukiriguru to potassium fertilizer. The figures are all fairly high and where they tend to be lower this can be attributed to the uptake by the bigger crops taken from the particular plots or to loss of bases following the use of sulphate of ammonia. Compost appears to be making some contribution to the potassium supply, but where sulphate of ammonia is also given compost has had no effect.

The main reason for the lack of response to potassium seems to be that there is ample potassium in the soil which, being derived from granite, still shows appreciable amounts of mica.

Table 12 and Table 13 show that there is now a range of fertility levels in Trial 26, related closely to the nitrogen, phosphorus and calcium levels. It is proposed to carry out an investigation of the relative contributions of these nutrients to the yields from the various treatments. The information obtained will also be used to get an indication of the meaning of the various soil-test values.

A start has been made at looking into the *Ibushi* soils of the south of Sukumaland. These soils are increasing in importance from the point of view of cotton production and their fertilizer requirements will be investigated. Some preliminary data are as follows.

Soil analysis of Ibushi surface soil

pH	8·12
Total N %	0·25
Organic carbon %	2·37
Truog P mg per 100g.	1·8
Sodium	Very small

These soils are derived from limestone and have high calcium and high pH. They seem to be appreciably richer than the hillsands in organic carbon, nitrogen and phosphorus. This may account for the reported lack of response to fertilizers when they were first tried.

Entomology

BY

W. REED and I. A. D. ROBERTSON*

Pest Attack 1962

This season was notable for its very heavy *Heliothis armigera* (Hb.) infestation. This was the first really heavy attack by this pest since 1956. The attack started on cotton in mid February, peak damage was recorded in March and by mid April the attack had generally abated.

Earias spp. were common pests of cotton in all areas visited. The attack was first noted in January when the larvae were found attacking the cotton growing points. *Earias* populations built up to a peak in May when most larvae were found inside the cotton bolls.

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Platyedra gossypiella (Saund.) populations built up at the end of the cotton season in all areas visited. In spite of intensive propaganda, many fields of cotton have not been uprooted and burnt in the 1962 close season. This close season has been unusually wet, and consequently the cotton has retained its leaves. This standover cotton is carrying buds, flowers and bolls and is heavily infested with *P. gossypiella* and *Earias*. A fairly heavy attack from these pests can therefore be expected in the 1963 season.

Populations of the "sucking insects" were quite low around Ukiriguru and little damage was noted but 100 miles to the south, at Shinyanga, the stainers, *Dysdercus* spp. were numerous and were causing some crop loss. *Calidea dregii* Germ. and *Nezara viridula* (L.) also contributed to crop loss in the Shinyanga area. The UK55 and UK58 varieties, which were bred for jassid resistance, were notably free from jassid in all areas. Severe lygus damage was generally to the west of Ukiriguru, in Geita district. To the west of Geita, attacks of *Helopeltis bergrothi* Reut. var. *rubra* Ghesq. were locally severe but not widespread.

Detailed Pest Studies

A detailed study of the biology and ecology of *H. armigera* was initiated in 1962.

Preliminary observations indicate that the first generation was a very low population feeding on a wide range of hosts in November and December. *Abutilon* spp., *Cleome* sp. and several Leguminosae, both cultivated and wild, were found to be hosts to this first generation.

The bulk of the second generation larvae fed, mainly on early sown maize, in December and January. The third generation fed mainly on cotton in February and March, this being the generation which caused most of the damage to cotton in the 1962 season. The fourth generation also fed on cotton, but in spite of very heavy egg laying, this generation did little damage to the cotton, for very few larvae developed.

The fifth and sixth generations were of very low populations, the larvae feeding mainly on the cultivated legumes. In August, September and October the larvae were not found.

Studies in the laboratory showed that, throughout the season from February onwards, about 2% of the pupae entered diapause. This observation is based on pupae, collected as sixth instar larvae from the field, pupated in the insectary and stored at about 24°C in the laboratory. Diapause studies under field conditions were not possible in the 1962 season. Soil troughs, protected from ants, have now been constructed and these will be in use in 1962-63.

It seems probable that *Heliothis* bridges the dry season, from August to November, as diapause pupae, since no larvae or moths have been found during this period. Emergence from diapause occurs in the period October to November giving rise to the first generation larvae which feed on a wide range of host plants. This generation has a very low population, but it can build up into a massive population on cotton in another two generations, one on maize, because of its high fecundity. In the laboratory at Ukiriguru, 58 females laid on average 1,226 eggs each, with a maximum of 3,065.

After the progressive population build-up of *Heliothis* in the first three generations, the fourth generation in April was greatly reduced. By this time predation and parasitism were very high. Over 50% of *H. armigera* larvae, collected from the field after mid April, were parasitized. Predation was difficult to assess, but many predators, including ants, mason wasps, Chrysopid larvae and Pentatomids were noted as predators in the field. Larvae were also killed by a polyhedral virus and a fungal disease.

Further evidence, indicating that parasites and predators were of primary importance, was gained from some insecticide-sprayed cotton. By mid April most farmers' *shambas* were virtually free of *Heliothis,* but on cotton which had been sprayed with DDT to kill the third generation, the fourth generation continued as a very high population of larvae into May. It is thought that early spraying had killed off the controlling agents, which severely reduced the fourth generation population on unsprayed cotton.

The parasites of *Heliothis* are being closely studied. It has been found that one of the pupal parasites, *Goniophthalmus halli* Mesnil, has a diapause synchronized with that of its hosts.

Experiments reported in an earlier section of this report, showing that early deflowering of some of the Ukiriguru strains of cotton can result in increased yields, are of obvious importance in the studies of crop loss caused by *Heliothis.* This pest has in many years been recorded as causing early bud and flower shedding, but later damage has been less common. Loss of the early flowers does not necessarily mean a reduction of crop, perhaps even the reverse.

Earias reaches its highest populations and does most of its damage to bolls later in the season. Such damage can be regarded as direct crop loss, for it is so late that compensation is not possible. It seems likely that, in most years, *Earias* causes more crop loss than *Heliothis,* although the latter is by far the more spectacular.

Studies of the biology and ecology of *Earias* also have been initiated. Of the spiny bollworms collected from cotton, well over ninety per cent were *Earias biplaga* Wlk.; the rest were all *Earias*

insulana (Boisd.). In the dry season on wild host plants, mainly *Abutilon* spp. and *Hibiscus* spp., more than 90% of the larvae collected were *E. insulana*. *Earias cupreoviridis* (Wlk.) has been recorded from the light trap but has not been found on any host plant.

On cotton which was sprayed early with DDT to control *Heliothis*, there was an exceptionally heavy attack of *Earias*; counts indicated a larval population of 30,000 per acre in mid May. Many of the predators and some of the parasites which control *Heliothis* are also active against *Earias*. It is thought that the DDT spraying reduced these controlling agents and so indirectly increased the *Earias* attack.

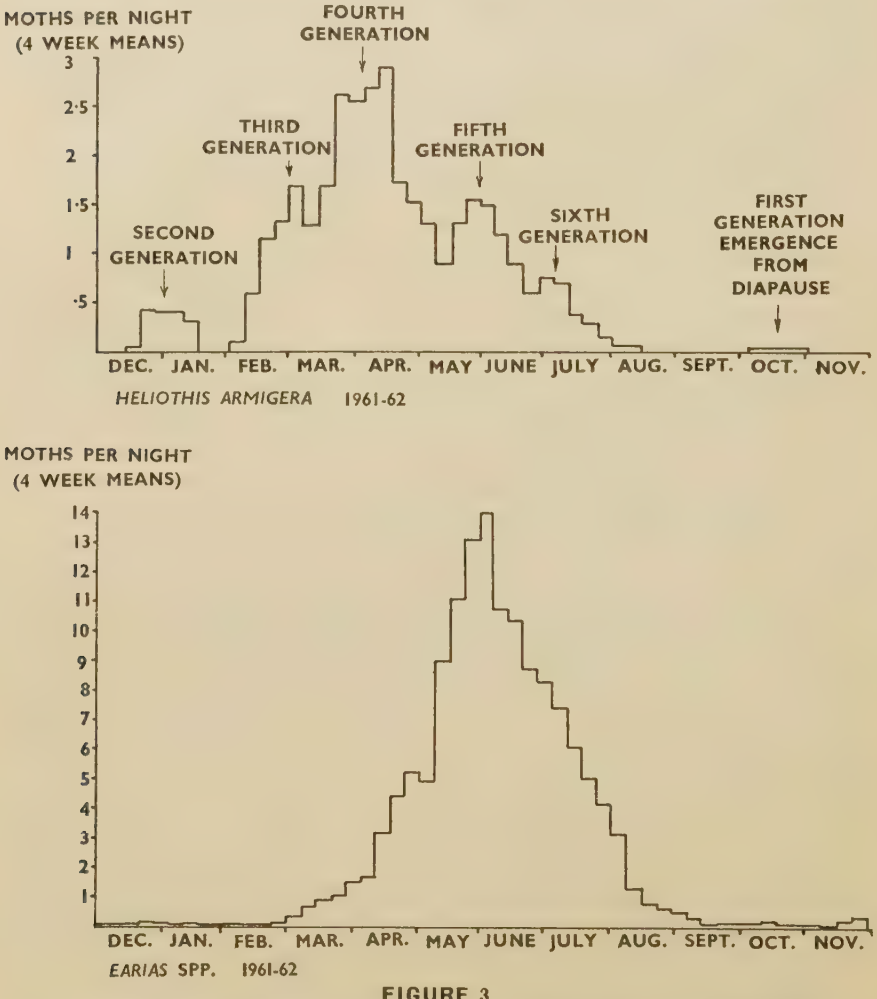

FIGURE 3

LIGHT TRAP CATCHES AT UKIRIGURU, EXPRESSED AS FOUR-WEEK MEANS, MOVING WEEKLY

Light trap records, illustrated in Fig. 3, show the differences in build-up of the *Heliothis* and *Earias* populations. *Heliothis,* which is thought to bridge the gap between August and November as diapause pupae, built up to peak larval populations on cotton in February and March. *Earias* was found at a low level on its wild hosts throughout the year; then built up on the cotton to peak larval population in May. In 1962 the separate generations of *Heliothis* showed up distinctly in the light trap catches and the timing of these is in agreement with the laboratory finding of a life cycle of six to seven weeks for this pest. The data are presented as histograms of four week averages, moving weekly. This presentation has the advantage of ironing out moon effects, but tends to blur the definition of the *Heliothis* generations.

Further work is essential on the assessment of crop loss due to *Heliothis* and *Earias*; this will be attempted in future seasons. Biological and ecological studies of these two pests will be continued and expanded as facilities and staff permit.

Insecticide Use

Much of the multiplication cotton on Ukiriguru was sprayed with DDT in 1962. The use of small hand sprayers on large blocks of cotton gave poor plant coverage and consequently poor pest control. A tractor-mounted sprayer will be in use on Ukiriguru in the 1963 season.

Two spraying trials were carried out.

Comparison of insecticides.—Timely sown, well grown cotton was sprayed six times at fortnightly intervals, the first spray being applied 12 weeks after sowing. The five treatments listed below were repeated five times in plots of 0·31 of an acre.

DDT at 1·05 lb per acre.
Toxaphene at 2·8 lb per acre.
DDT at 0·93 lb plus toxaphene at 1·9 lb per acre.
Sevin at 1·6 lb per acre.
Control, no spray.

Yields were so varied both within and between treatments that a full presentation of plot yields is more informative than their means (Table 14).

TABLE 14

COMPARATIVE TRIAL OF INSECTICIDES

Individual plot yields from five replications and treatment means lb seed cotton per acre

Treatment	*Plot yields*					*Mean*
DDT	1,198	870	512	715	669	793
Toxaphene	366	423	210	308	347	331
DDT + Toxaphene	1,373	797	1,019	827	801	974
Sevin	286	233	125	198	64	181
Control	716	127	102	38	24	202

The yields and field observations both showed that Sevin and toxaphene gave poor control of *Heliothis*. The low yield on the control is not thought to be indicative of what unsprayed cotton would have yielded in the absence of sprayed cotton. Local farmers' cotton, unsprayed but on soil of comparable fertility, yielded about 800 lb seed cotton per acre. It is suggested that the preponderance of sprayed cotton in this trial upset the balance between the pests and their controlling agents in these control plots.

Time of spraying.—Cotton was sprayed six times at fortnightly intervals using DDT at 1 lb in 13 gallons of water per acre. Plot size was 1/13 acre sprayed, 1/33 acre harvested. The five treatments listed below were repeated six times.

A Control, no spray.
B Spraying started five weeks after sowing.
C Spraying started seven weeks after sowing.
D Spraying started nine weeks after sowing.
E Spraying started eleven weeks after sowing.

Three plots, one each of B, C and E, had to be discarded before harvesting owing to extremely poor stands. Results are given in Table 15.

TABLE 15

COMPARISON OF TIMES OF SPRAYING

Individual plot yields and treatment means in lb seed cotton per acre for unsprayed control and sprayings starting at different numbers of weeks from sowing

Each spraying treatment was six sprays of 1 lb DDT per acre at fortnightly intervals

	Plot yields						*Mean*
Unsprayed control	204	369	878	478	575	282	465
Spraying from 5 weeks	739	693	542	614	581	—	634
Spraying from 7 weeks	755	704	614	656	838	—	713
Spraying from 9 weeks	796	629	720	800	631	732	718
Spraying from 11 weeks	786	840	633	767	986	—	802

It is of interest to note that the first pickings on B, C and D were all equal, thus indicating that spraying in the fifth and seventh weeks gave no yield advantage and was therefore unnecessary. Omission of the ninth week spray gave a lower first picking; the reduction was undoubtedly due to *Heliothis* damage in the tenth week. The plots in which spraying started at eleven weeks finally outyielded all of the others. This could well have been a twofold effect: of early deflowering (as in the experiments referred to above), and longer protection against the later pests, especially *Earias*.

Future Insecticide Work

Past results of insecticide use at Ukiriguru and its sub-stations have been very variable. Much more exploratory work is essential before local use of insecticides on cotton can be recommended or discouraged.

At present, in most years, quite good crops of cotton are grown locally without the use of insecticides. Under the present local farming conditions, insects do not appear to be the major limiting factor to yields. With the introduction of widespread use of fertilizers and the adoption of better farming methods, it is probable that pests would become a more serious limiting factor and that insecticide use could then become essential.

Bacterial Blight

BY

J. E. CROSS

Work on Resistant Strains

A total of 70 UKA selections were screened at Ukiriguru for stem and boll resistance to bacterial blight. It was apparent that the vast majority of the selections were highly resistant to *Xanthomonas malvacearum* isolates from UK55 and UK58. There appeared to be very little variability in bacterial blight resistance, and low heritability estimates (presented in Table 16) confirmed this observation.

Table 16

Heritability estimates for stem and boll resistance in some uka selections

Family	*Stem resistance*	*Boll resistance*
UKA 67 (59 selections)	zero	zero
UKA 67 (K strains)	0·659	0·245
UKA 121	zero	0·279

In this season, the only exploitable variability for bacterial blight resistance would seem to be in the K strains. These strains were originally selected for high bacterial boll rot resistance.

Races of Xanthomonas malvacearum

Several glasshouse inoculation techniques have been tested, and hypocotyl inoculation has been found to be the best. This method is essentially similar to the stem inoculation technique used in the field, and combines accuracy with speed.

A number of differential varieties have been examined and 18 have been chosen for the race work. These varieties contain all the known

resistance genes in a *Gossypium hirsutum* background, so far as they are available. The other differential varieties were all bred in Tanganyika.

It has been possible to isolate and maintain the bacterial blight pathogen, without recourse to artificial culture. Infected material is soaked in water, and the resultant bacterial suspension is then inoculated into leaves of the highly susceptible variety IL47/10. The infected leaves are used as a source of inoculum for hypocotyl inoculation.

The main work has been to compare the virulence of bacteria collected from the moderately susceptible variety UK51, and from the highly resistant strain UKA 59/513. This work has been reported more fully elsewhere, but the general trends are summarized in Table 17.

TABLE 17

HYPOCOTYL LESIONS IN VARIETIES INOCULATED WITH TWO X. MALVACEARUM POPULATIONS

Range of mean lesion length in mm transformed to log $(x + 1)$

Varieties	*Resistance genes*	*UK 55 population*	*UKA 59/531 population*
Sus 7/2, IL47/10	b	1·28-1·34	1·20-1·27
3 UKA strains	?	0·91-0·93	1·23-1·26
Bar 12/16	B_2B_6	0·72	0·77

Obviously the populations differ in virulence, and the stem resistance of the UKA strains breaks down, in glasshouse-grown seedlings, under the impact of a population of the pathogen collected from a naturally infected UKA strain in the field. Whether this will occur in field-grown plants remains to be determined.

Resistance Genes

In view of the possibility that none of the present resistance gene combinations will be effective against new races of *X. malvacearum*, a number of new gene combinations have been made. These are:— B_2B_4, B_4B_6, $B_2B_9B_{10}$, $B_6B_9B_{10}$, $B_2B_3B_7$, $B_2B_4B_6$, and $B_2B_6B_7$.

FUSARIUM WILT

BY

G. M. WICKENS

Spread of the Disease

Effective restriction of spread, by controlling movement of seed, requires exact knowledge of where the disease exists and where it does not. The Departmental annual survey is thus of fundamental importance. This year's results have shown a continued slow spread in Geita District, where the number of *shambas* known to be infested

now exceeds 1,000. The survey also revealed new widely scattered foci of infection in the important production and seed multiplication East Lake areas, one of them as much as 40 miles from the Lake shore.

Approximate positions of known Fusarium wilt are indicated on the map (Fig. 1).

Circumstantial evidence suggested that these new disease centres, far removed from any previously known, may have originated from discarded cotton seed husk, removed in the process of decortication at oil mills. That this could be so has been proved by isolation of the cotton wilt *Fusarium* from externally sterilized seed coats taken from infected plants, and by proving pathogenicity of the isolates in inoculation experiments. It has been recommended that measures be taken to prevent this means of dissemination in future, as well as to restrict and, if possible, eliminate, further spread from the new foci already established.

"Lubaga wilt", very similar in its symptoms to Fusarium and Verticillium wilt, still occurs in southern areas, although as far as is known it is not yet materially damaging to crop production. In spite of many attempts by a variety of methods to isolate a causal organism, the cause continues to defy analysis. It now appears highly improbable that it can be ascribed to either *Fusarium* or *Verticillium*.

This is the first season at Ukiriguru in which full glasshouse and laboratory facilities have been available for work on Fusarium wilt. Most of the work has been in two main lines, as follows.

Studies on Host Resistance

A new glasshouse method has been developed for detecting and, if present, evaluating heritable resistance. By this means, a high degree (heritability 0·58) has been found among 45 progenies in the UKA G2.1 family of Albar hybrids. It remains to be determined whether the resistance can be effective in the presence of root-knot eelworm attack in the field. Details of the method and of the results achieved will be published elsewhere.

Studies on the Causal Organism in the Soil

Many established methods, and variations of them, have been used for examining the fate of *Fusarium oxysporum f. vasinfectum* when introduced into soils from various places, at various depths, and that had been subjected to varying manurial treatments. Strong fungistasis has been found in many soil samples taken from the top foot, especially where dung and superphosphate had been applied. Sulphate of ammonia applications appear to have weakened the effect somewhat. At depths of 2 to $2\frac{1}{2}$ feet and below, the effect was much reduced. Lysis of the mycelium of the *Fusarium* has been observed

in some samples, but complete destruction of the introduced fungus has not yet been observed. Actinomycetes, antagonistic to the *Fusarium* in pure culture, have been isolated.

Results so far have led to formulation of the working hypothesis that establishment of new disease foci may be rendered more precarious by dung and superphosphate manuring. Further work will examine the validity of the hypothesis.

In some of the experiments, *Verticillium dahliae,* found to be the main cause of cotton wilt in E. and N. Regions of Tanganyika and in the Nyanza Province of Kenya as well as in Uganda, has also been studied. Results so far are inadequate to form any hypothesis on the influence of soil factors on its growth and survival.

Publications

Recently published papers, written in whole or in part by members of the staff, are listed below.

Brown, K. J. (1962). "Effect of early rainfall on the response of cotton to nitrogen". *Emp. Cott. Gr. Rev.,* **39**, 177.

Brown, K. J. (1963). "Rainfall, tie ridging and crop yields in Sukumaland, Tanganyika". *Emp. Cott. Gr. Rev.,* **40**, 34.

Cross, J. E. (1962). "Gossypol content of cottonseed". *Emp. Cott. Gr. Rev.,* **39**, 136.

Peat, J. E., and Brown, K. J. (1962). "The yield responses of rain-grown cotton, at Ukiriguru in the Lake Province of Tanganyika. I. The use of organic manure, inorganic fertilizers, and cotton-seed ash". *Emp. J. exper. Agric.,* **30**, 215.

Peat, J. E., and Brown, K. J. (1962). "The yield responses of rain-grown cotton, at Ukiriguru in the Lake Province of Tanganyika. II. Land-resting and other rotational treatments contrasted with the use of organic manure and inorganic fertilisers". *Emp. J. exper. Agric.,* **30**, 305.

Reference

Brown, K. J. (1963). "Rainfall, tie ridging and crop yields in Sukumaland, Tanganyika". *Emp. Cott. Gr. Rev.,* **40**: 34.

Appendix

Origin and Special Characteristics of the Main Cotton Strains Mentioned

Local	A mixture of Upland types introduced into the Lake Province from the turn of the century onwards—mainly from Uganda and Nyasaland.

MZ561	A straight selection from Local, first multiplied in 1939-40 season.
UK51	A multiline seed issue incorporating strains with jassid resistance, first multiplied in the 1951-52 season.
UK55	A multiline seed issue composed of strains outstanding for yield and jassid resistance. First multiplied in the 1955-56 season.
UK58	A multiline seed issue of similar characteristics and genetic origin to UK55, first multiplied in 1958-59 season.
UK61	The first commercial multiline variety of Albar hybrid selection, combines high lint quality with good yield and jassid resistance. To be grown in the Northern area of Lake Region.
UK62	A high yielding multiline variety of Albar hybrid selections which also has a high ginning percentage. To be grown in the Southern area of Lake Region.
Albar	Nigerian Allen (A1) blackarm resistant (bar) selections. Two series of selections were made independently, Albar 49 in the Sudan in 1949, and Albar 51 in Uganda in 1951.
Albar hybrids	A general term embracing selections from crosses between Albar 51 and strains of Local origin, backcrossed to the locally adapted types. These are now all being covered under the general prefix of UKA.

Received February 1963.

PROGRESS REPORTS FROM EXPERIMENT STATIONS

The reports for the seasons up to and including 1950-51 were published in seasonal volumes; the following are still in print and available at 3/- per volume post free.

1923-25 (one volume), 1926-27, 1931-32, 1934-35,
1935-36, 1942-43 and 1945-46 to 1950-51.

From 1951-52 the reports from each territory were published individually each season. A few of the 1951-52 reports are out of print, but all others are available post free at 2/6 per report or £1 for the seasonal set.

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